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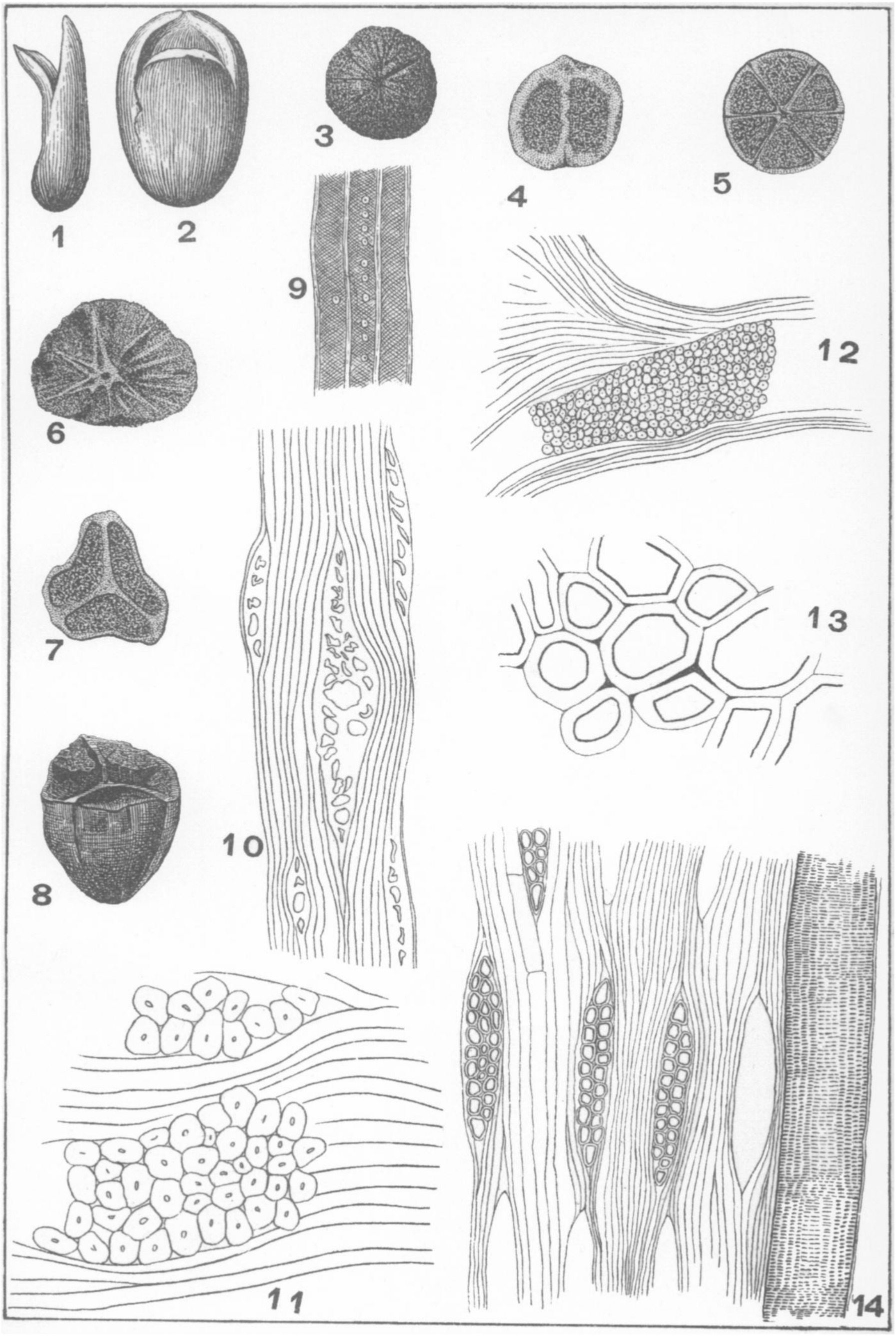

FOSSIL FRUITS AND LIGNITES.

HELIOTYPE CO., BOSTON.

Notes on the fossil Fruits and Lignites of Brandon, Vermont

By F. H. Knowlton

(With Plate 25)

It is now almost fifty years since Professor Edward Hitchcock published * the first account of the interesting lignitic deposit at Brandon, Vt. Many of the most characteristic species of fruits were figured and a general discussion given of the geological conditions under which they occur with an indication of the probable stratigraphic position. Later, in 1861, Professor Leo Lesquereux published an elaborate paper in which he gave careful descriptions of the species, with a discussion of the relationships of the flora with those of certain European deposits. These two articles were published without change, in 1862, in Hitchcock's *Geology of Vermont*, † and were further supplemented by a letter from Professor J. W. Bailey, ‡ to show specimens of the lignite and fruits which had been submitted for microscopical study. Professor C. H. Hitchcock described § a single species of *Carpolithes* in 1862, which completes the list of articles relating to the subject, with the exception of occasional mention in works on geology, etc.

Professor Hitchcock's account of the geology and mode of occurrence of this deposit is very complete, and I venture to give it in full:

" In the autumn of 1851 Professor Shedd, of Burlington, presented me with a few specimens of beautifully preserved fruits from Brandon, Vt. They were converted into brown coal, and retain exactly their original shape and markings. Early in the spring of 1852 I visited Brandon, and found that the fruits were obtained from a bed of brown coal connected with the white clays and brown hematite of that place. I perceived at once that an interesting field was open before me, and ever since I have been endeavoring to exploit it. * * * I shall first give a description of the topography and geological associations of this carbonaceous deposit."

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* Am. Journ. Sci. II. 15 : 95–104. 1853.

† Pp. 226–234 ; 714–718.

‡ *Op. cit.*, 239, 240.

§ Portland Soc. Nat. Hist. 1 : 95. *pl. 1. f. 5.* 1862.

Geologists are aware that along the west base of the Green and Hoosac Mountains, from Canada to New York, occur numerous beds of brown compact and fibrous hematite iron ore. That in Brandon lies between two and three miles of the village; the surface rises slightly and exhibits clay, drift and limestone rock in place. According to my measurements with the anëroid barometer, Brandon village is 465 feet above the ocean, and the iron mine 520 feet above the same. A short distance east of the mine the Green Mountains rise rapidly.

At this spot we find the following varieties of substances in juxtaposition:

1. Beautiful kaolin and clays, colored yellow by ochre, rose-color by manganese (?), and dark by carbon.
2. Brown hematite and yellow ochre.
3. Ores of manganese.
4. Brown coal.
5. Beds of gravel connected with the clays.
6. Drift overlying the whole.
7. Yellowish limestone underlying the whole.

The position of the clays is difficult to determine exactly, as there seems to have been a good deal of disturbance of the strata, perhaps only the result of slides. The coal, in a few places, shows itself on the surface. In one spot a shaft has been carried through it only a few feet below the surface, and this has also been done to the same bed nearly 100 feet below the surface. In both places it was about 20 feet thick. I found it to be the conviction of the miners that the mass of coal formed a square column of that thickness descending almost perpendicularly into the earth, in the midst of the clay. My own impression was that it is a portion of an extensive bed, having a dip very largely towards the northwest; perhaps separated from other portions of the bed by some disturbance of strata.

From the above account it will be observed that this deposit has the appearance of almost complete isolation in the midst of much older and totally different strata, and it is not strange that it excited the attention and wonder of geologists, and the question of its age became at once the subject of speculation. From purely geological data Hitchcock concluded that it must be Pliocene, or possibly still newer Tertiary in age, while Lesquereux, from a consideration of the flora and its general resemblance to that of Oeningen, inclined to place it in the Miocene. Dana has suggested that it may possibly be as old as the Eocene, a conclusion which later investigation will probably not sustain.

LIGNITE

The mine mentioned by Professor Hitchcock has long since fallen into neglect, and is now almost entirely filled up. The mining of iron was stopped more than thirty years ago and the only industry remaining is the mining and manufacture of mineral paints. The only trace remaining of this extensive lignitic deposit is the mass of minute fragments scattered about the mouth of the shaft, and among which, by long and careful search, a few fruits are still to be found. For a description of the appearance of the lignite as it appeared when first taken from the mine, recourse must be had to Hitchcock's description, which is as follows:

" The greater part of the carbon of this deposit is in a condition between that of peat and bituminous coal. It is of a deep brown color, and nearly every trace of organic structure, save in the lignite and fruits, is obliterated. It burns with great facility with a moderate draught, and emits a bright yellow flame, but without bituminous odor.

" Interspersed through the mass of carbonaceous matter above described occurs numerous masses of lignite. In all cases which have fallen under my observation they are the broken portions of stems or branches of trees and shrubs, varying in size from that of a few lines to a foot and a half in diameter. They all appear to have been drift wood. This lignite, in all cases, retains and exhibits upon a first fracture its organic structure. Yet generally it is quite brittle, and when broken across the fibers, it has the aspect of very compact coal, which admits of a good polish."

The largest specimen obtained by Professor Hitchcock was four feet in length and sixteen inches in largest diameter. It is now in the museum of Amherst College. The largest specimen in my possession was given me by Dr. D. W. Prime, of Brandon.

It is almost twelve inches long and four inches broad. It breaks up very readily into small irregular fragments which appear destitute of structure on their transverse fracture, but when split along certain lines, notably in the direction of the medullary rays, very plain structure may be observed even with the naked eye. In general the only specimens that can be obtained for examination are small fragments hardly an inch in length. Most of the material upon which the following examination is based was kindly placed at my disposal by Professor H. M. Seely, of Middlebury College, and Professor George H. Perkins, of the University of Vermont.

Hitchcock was of the opinion that little if any of this lignite could be regarded as coniferous, while Bailey, in his letter before referred to, states positively that the woods "*are not coniferous.*" Contrary to these statements and my expectations, a large proportion of the lignite examined proved to be undoubtedly coniferous in character. These later results are perhaps due to improved methods of study, or possibly its character may differ in different parts of the area. This latter supposition seems hardly probable, however, as the area from which it was obtained has always been so limited.*

When specimens prepared as indicated above are placed under the microscope, a glance suffices to show that they have been much crushed and distorted by pressure. In transverse section the lumen of the cells is seen to be almost entirely obliterated, and they have been distorted in other ways. But by repeated selections of material and its careful study, points that have been especially favored during the processes of fossilization, are usually to be found, and from a study of these areas, in numerous examples, a pretty complete idea can be formed of its nature and appearance when living. The large specimen in my possession, mentioned above, was found to be undoubtedly coniferous. Selected sections from it show clearly the characteristic pits on the radial walls (*f. 9*). The walls of the tracheïds were also found to be thickened spirally on their interior. In longitudinal tangential section the ends of the medullary rays show plainly (*f. 10*). They have been considerably distorted, yet their arrangement can be made out. They are usually simple; that is consist of a single layer of cells, yet scattered among these are a few compound rays with a single included resin-duct, a well-known character of the genus *Pinus*. Indeed, after a careful study I am scarcely able to distinguish the Brandon lignite from a species of *Pityoxylon* described by Schmalhausen* from the Eocene and Braunkohle of southwestern Russia. The material studied by Schmalhausen was better preserved and he was able to work out the details of structure in a more satisfactory manner than is the case with the Brandon material. Yet on the whole I am inclined to regard them as of only varietal difference. Schmalhausen has named the Russian species *Pityoxylon microporosum*. For the Brandon form I propose the name *Pityoxylon microporosum Brandonianum*.

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* To prepare this lignite for examination by transmitted light the directions given by Griffith and Henfrey in the *Micrographic Dictionary*, second edition, p. 178, are very satisfactory. The specimens are to be macerated in a strong solution of carbonate of potash for a few days, when they may be cut into thin sections with a razor. These thin pieces are boiled for a few moments in nitric acid, or until they become light brown in color. They are then washed out in pure water and mounted in glycerine.

The type is described as follows: Annual rings plainly marked, rather thick; medullary rays moderately numerous, the simple ones 1–7 cells high, the larger enclosing the resin duct about 18 cells high; wood-cells marked by numerous lines, the pores small and remote; pores on the medullary rays large, oval, 1–2 to the width of each wood-cell.

The Brandon form differs in the narrower annual rings and the smaller size of the cells in general. It is not well enough preserved to show markings on the medullary rays if these be present. The walls of the tracheïds are thickly covered with fine spiral lines and the bordered pits are also smaller than in the type. The contents of the resin-tubes can not be made out.*

While as already stated the bulk of the lignite examined proved to be coniferous, I fortunately secured one small but well preserved piece that was with equal certainty dicotyledonous. The accompanying figure (*f. 14*) shows it in longitudinal tangential section, and brings out the fact that it was provided with large dotted ducts and numerous medullary rays, the latter of about uniform size and two or rarely three layers of cells side. It suggests a wood allied to *Betula*, but of this I am uncertain.

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* Beitr. z. Tertiär-Flora Süd-West-Russlands: Palaeont. Abhandl. von Dames u. Keyser, 1 : 334. *pl. 41. f. 1–3.* 1884.

† At this point my study was interrupted and consists of a few scattered notes on a few species. It had been my intention to take up each form and subject in a careful microscopical study. As I can not hope to finish it along these lines for some time, if ever, I present the following fragments with due apologies for their disconnected nature, and in the hope that they may prove of some value should any one desire to take up the investigation.

One of the most abundant and conspicuous of the fruits was named *Carpolithes Brandonianus* by Lesquereux. As may be seen from the figures 1, 2, it is a large flat fruit with the opening a little below the apex. It has been suggested that its affinity is possibly with the living *Jeffersonia diphylla*, the well-known twin-leaf. Unfortunately most of the material at my disposal could not be used for sections, and I was obliged to confine my investigations to imperfect specimens. A section through the basal portion showed the thick fruit to be made up of very thick-walled tissue in which the lumen was reduced to a mere point (*f. 11, 12*). It had been so distorted that its true relationship could not be made out, more especially as the sections could not be made in the same plane through the whole fruit. Its appearance is shown in the two figures. I was not at the time able to secure working material o the capsule of *Jeffersonia*, so I am unable to speak of the relationship beyond the superficial resemblance, which is really striking.

Among the fruits sent me by Professor Seely and which were afterward sent to Lesquereux, was a single small nearly spherical fruit named *Carya globulosa* by Lesquereux himself. This was the first intimation of the existence of a species under this name, and for a time it proved a complete puzzle. Subsequently in looking over the collections belonging to the U. S. National Museum I found a small box containing fruit under this name, and in the catalogue the information that the species was unpublished.

This fruit may be described as follows (*f. 3–5*): Specimens almost completely spheroidal in shape, being only very slightly compressed at the apex. Some of the fruits have retained what seems to have been a thin outer covering or exocarp which entirely enveloped them. Through this thin exocarp the wrinkling or roughening of the true capsule is very plainly discernible, and in this condition they really very much resemble some living species of *Juglans* or *Hicoria*, which are provided with an indehiscent exocarp.

When this center covering is removed, several valves become apparent, and when the specimen has been macerated in the potash solution, may be very readily separated into six nearly equal valves. This shows that it can not possibly belong to either *Hicoria* or *Juglans*, for which, when still covered with the exocarp, it might be mistaken.

In its decorticated condition this capsule bears a very strong resemblance to species of *Cucumites* detected in the London clay by Bowerbank, particularly the six-valved form of his *C. variabilis*. It is also similar to what Lesquereux has called *Apeibopsis*, but all things considered it is probably best referred to the former genus. In view of the fact that the *Carya globulosa* was never actually published, it may be appropriate to name it in honor of Lesquereux who first detected it. It may be called *Cucumites Lesquereuxii*.

Explanation of Plate 25

FIG. 1. *Carpolithes Brandonianus* Lesq. Lateral view.
FIG. 2. *Carpolithes Brandonianus* Lesq. Front view.
FIG. 3. *Cucumites Lesquereuxii* sp. nov. Basal view.
FIG. 4. *Cucumites Lesquereuxii* sp. nov. Split along median line.
FIG. 5. *Cucumites Lesquereuxii* sp. nov. Transverse section.
FIG. 6. *Aristolochites* sp.
FIG. 7. *Tricarpellites fissilis* Lesq.
FIG. 8. *Tricarpellites fissilis* Lesq.
FIG. 9. *Pityoxylon microporosum Brandonianum* var. nov. Radial.
FIG. 10. *Pityoxylon microporosum Brandonianum*, tangential.
FIG. 11. *Carpolithes Brandonianus* Lesq. Section near base, × 310.
FIG. 12. *Carpolithes Brandonianus* Lesq. Section near base, × 90.
FIG. 13. *Aristolochites*. Section near middle, × 310.
FIG. 14. Dicotyledonous wood. Tangential section, × 310.